

# Test Facility Management Plan (TFMP)

## Appendix 3.1

**Korea Marine Equipment Research Institute**

# Test Facility Management Plan (TFMP)

## Agreement for under control of BioViolet™ BWMS

This document has been prepared to ensure the quality of control for testing of BioViolet™ BWMS. All activities including BioViolet™ BWMS process, test facility maintenance, cleaning and operation must be controlled under KOMERI's supervision.

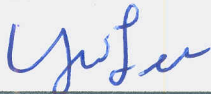
Kwang San Co., Ltd. and KOMERI agree as follows:

- From 18 February 2011 to 31 December 2011, BioViolet™ BWMS must be under the control of KOMERI.
- The whole situation (operation, maintenance and so on) of BioViolet™ BWMS must be reported KOMERI in detail and come into action with KOMERI's agreement.
- Concomitants of land-based test for the IMO Final Approval and Type Approval must be performed in the presence of KOMERI. And data of performances will be accompanied by a COC format at each time and then bound for keeping in accordance with KOMERI QAPP.
- If Kwang San Co., Ltd. breaks this agreement, Kwang San Co., Ltd. put up with any disadvantages.

In witness whereof the parties hereto have caused this agreement to be executed the day and year first before written in accordance with their respective the laws.

President : Young-Woo Lee

Signature :



February 2011

President : Gi-Jung Kim

Signature :



February 2011



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## **1. OPERATION PROCEDURE AND MAINTENANCE**

### **1.1 BioViolet™ overview**

Since BioViolet™ developed by Kwang San Co., Ltd. mechanically and physically disinfects aquatic organisms using filter and UV system, it does not inflict secondary pollution of the sea from by-products and corrosion problem of the hull, more effectively guaranteeing safety of crew.

BioViolet™ is composed of filter, UV system, and control system that includes power panel. Sufficient filtration area was secured to minimize pressure drop in the filter, and a material strong against corrosion was selected as filter element for semi-permanent use. Also, the filter performs automatic back-flushing by sensing differential pressure between inlet and outlet. Since such differential pressure is adjustable, flexible response to varying ship installation conditions becomes possible.

UV system selected a medium pressure/high intensity UV lamp to greatly reduce quantity of UV lamps, allowing more convenient maintenance. In addition, the chamber that can either be installed horizontally or vertically was designed with special shape to significantly reduce its footprint. UV system used two UV intensity sensors for mathematical computation of intensity and water quality inside the chamber, which results in disinfection of aquatic organisms with optimal energy efficiency.

Control system controls and monitors the entire BioViolet™ Touch screen technology allowed convenient operation of the control system. Also, the control system stores all records from operating process, and transmits or receives important data such as alarms with the central control system through communication.

Operation procedure and checklist will be established by Kwang San Co., Ltd. and the whole concomitant in connection with Land-based test will be under the control of KOMERI.

### **1.2 Test preparation**

#### **1.2.1 Ballasting operation**

The test water is made in tank 1 and tank 2 prior to ballasting operation to make identical conditions during ballasting operation. Agitator is operated to maintain homogeneity of test water in the tank during ballasting operation.

#### **1.2.2 De-ballasting operation**

Agitator is operated to maintain homogeneity of test water in the tank during de-ballasting operation.

### **1.3 Ballasting operation**

#### **1.3.1 Treated water**

After receiving ‘Pre-ballasting (Treated) Mode ON’ signal from the main controller of the test facility as the ship’s central control system, the control system of BioViolet™ performs pre-heating of UV lamp. Here, the main controller opens main pipe valves that do not belong to the scope of control by the BioViolet™ controller. Once pre-heating of lamp is complete, the BioViolet™ controller opens valves within its control scope. Here, ballasting operation on treated water begins with ‘Ballasting (Treated) Mode ON’ signal from the main controller. Test water in tank 2 passes through the filter and UV system by ballast pump and is transferred to tank 3.

In this process, the flow meter is used for real-time control of ballast pump for consistent maintenance of the main pipe flow.

During ballasting operation, most of aquatic organisms and particles in test water larger than 50 µm are strained by the filter. Furthermore, aquatic organisms not removed by filtration process are effectively disinfected when passing through UV system.

During these processes, as the BioViolet™ controller continuously controls UV lamp output using signals received from UV intensity sensor, aquatic organisms are disinfected at optimal energy efficiency. Figure 1 shows transfer path of the treated water during ballasting operation as a red line.

Sampling was conducted three times during ballasting operation by KOMERI with a constant time interval.

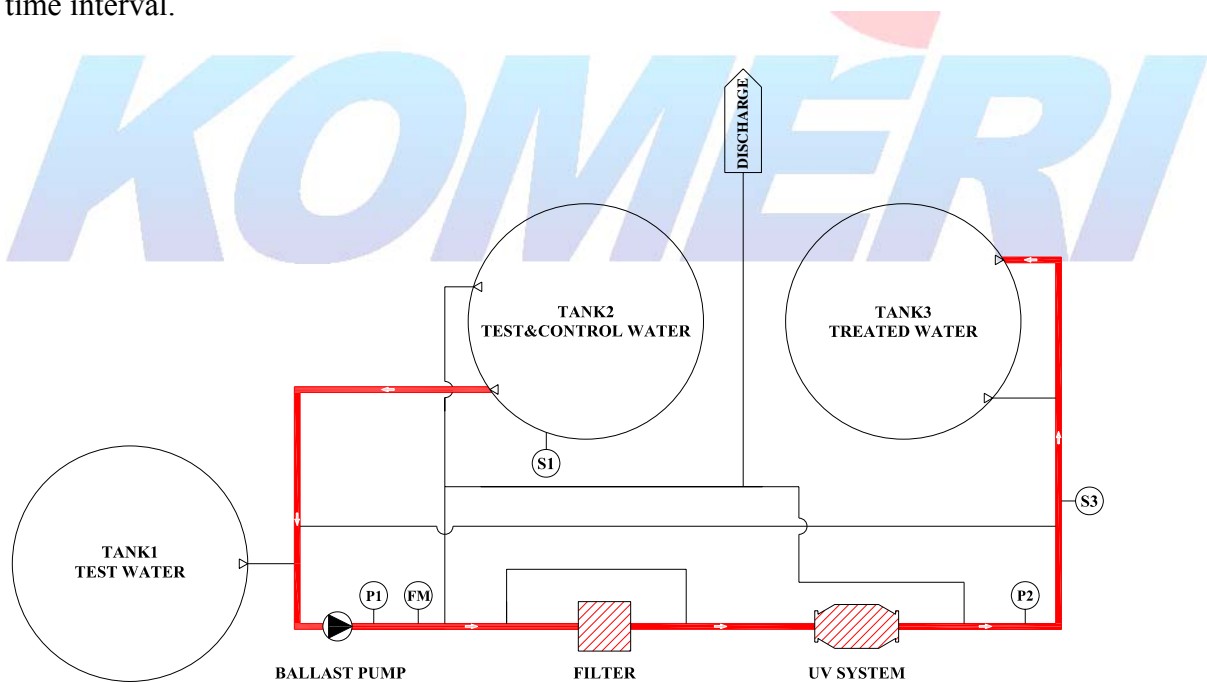


Figure 1. Ballasting operation of the treated water

### 1.3.2 Control water

The main controller of the test facility opens main pipe valves and controls ballast pump to begin ballasting operation on the control water. Test water is transferred from tank 1 to tank 2 by the ballast pump. During this process, flow meter is used for real-time control of ballast pump to ensure that flow of the main pipe is kept constant.

Figure 2 shows transfer path of the control water during ballasting operation as a blue line. Sampling was conducted three times during ballasting operation by KOMERI with a constant time interval

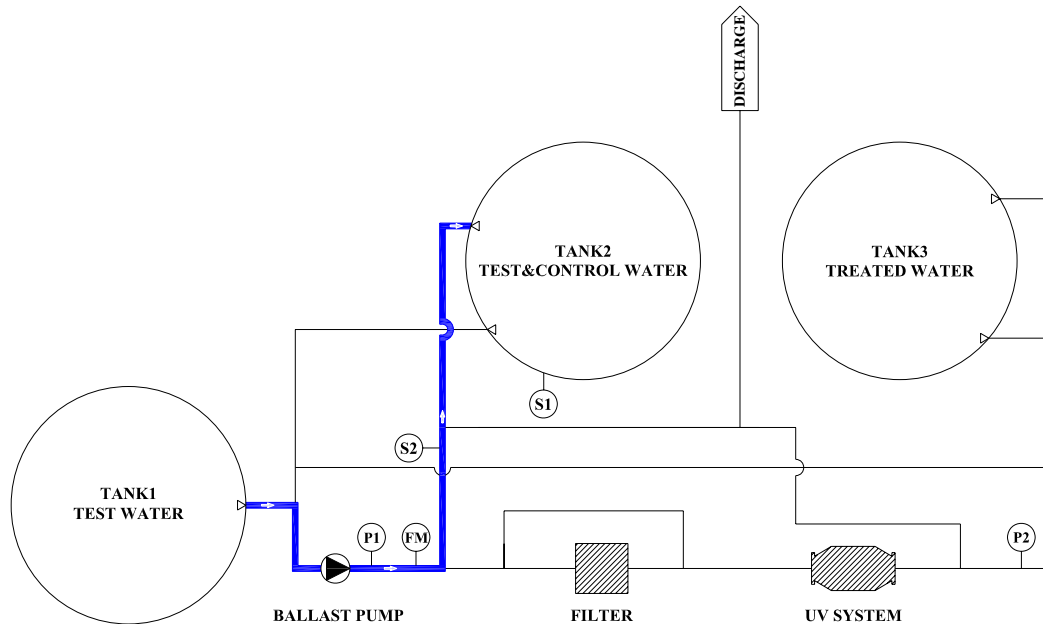


Figure 2. Ballasting operation of the control water

## 1.4 Storage

The control water and treated water transferred at treatment rated capacity (TRC) by the ballast pump are respectively stored in tank 2 and tank 3 for five days. During this storage period, tanks are completely blocked from light.

## 1.5 De-ballasting operation

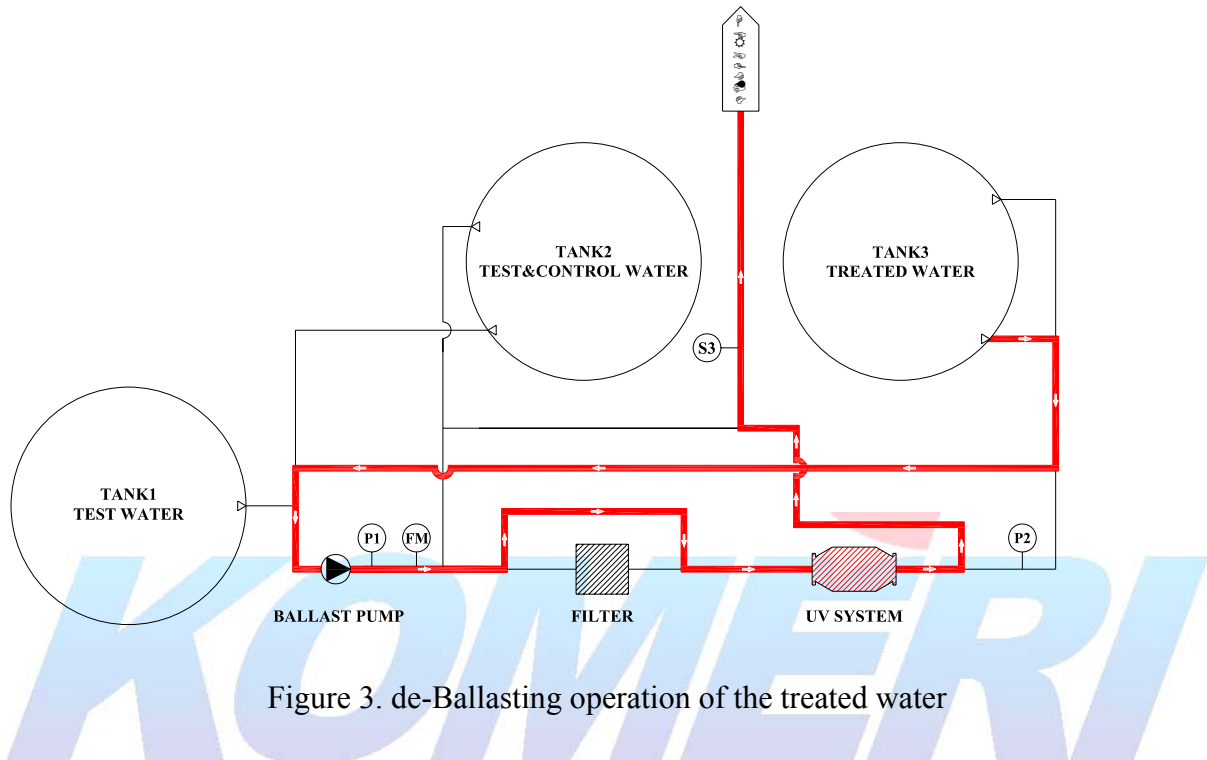
### 1.5.1 Treated water

The control system of BioViolet™ starts with pre-heating of UV lamp after receiving ‘Pre-de-ballasting (Treated) Mode ON’ signal from the main controller of the test facility. Here, the main controller opens main pipe valves that do not belong to the scope of control of the BioViolet™ controller. Once pre-heating of UV lamp is complete, the BioViolet™ controller opens valves within its control scope. Here, de-ballasting operation on the treated water starts by ‘De-ballasting (Treated) Mode ON’ signal from the main controller.

Treated water in tank 3 is discharged by ballast pump after passing through the UV system. Though the filter is not used in de-ballasting operation, UV system is used once again to disinfect any aquatic organisms that had not been removed during ballasting process. In this process, flow meter is used for real-time control of ballast pump to maintain flow of main pipe.

For disinfection of aquatic organisms with optimal energy efficiency during de-ballasting process, the BioViolet™ controller continuously controls UV lamp output using signals received from the UV intensity sensors.

Figure 3 shows transfer path of the treated water during de-ballasting operation as a red line. Sampling was conducted three times during ballasting operation by KOMERI with a constant time interval.



### 1.5.2 Control water

The main controller of the test facility opens main pipe valves and begins with de-ballasting operation on the control water by controlling the ballast pump. The control water in tank 2 is discharged by the ballast pump. In this process, flow meter is used for real-time control of the ballast pump to maintain flow of the main pipe.

Figure 4 shows transfer path of the control water during de-ballasting operation as a blue line. Sampling was conducted three times during ballasting operation by KOMERI with a constant time interval.

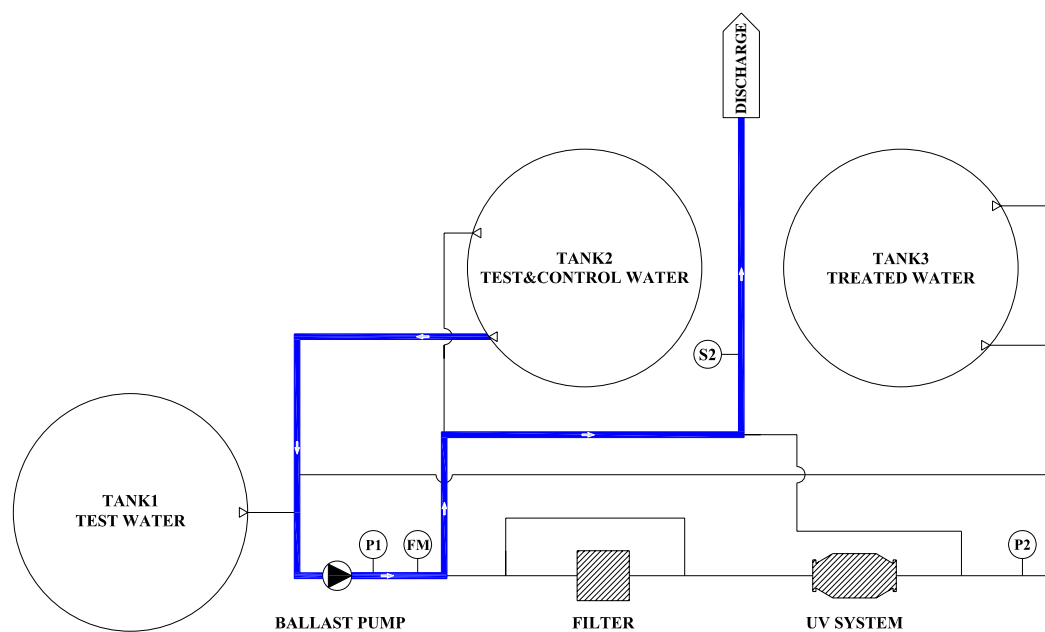


Figure 4. de-Ballasting operation of the control water

**KOMERI**

## 1.6 Maintenance

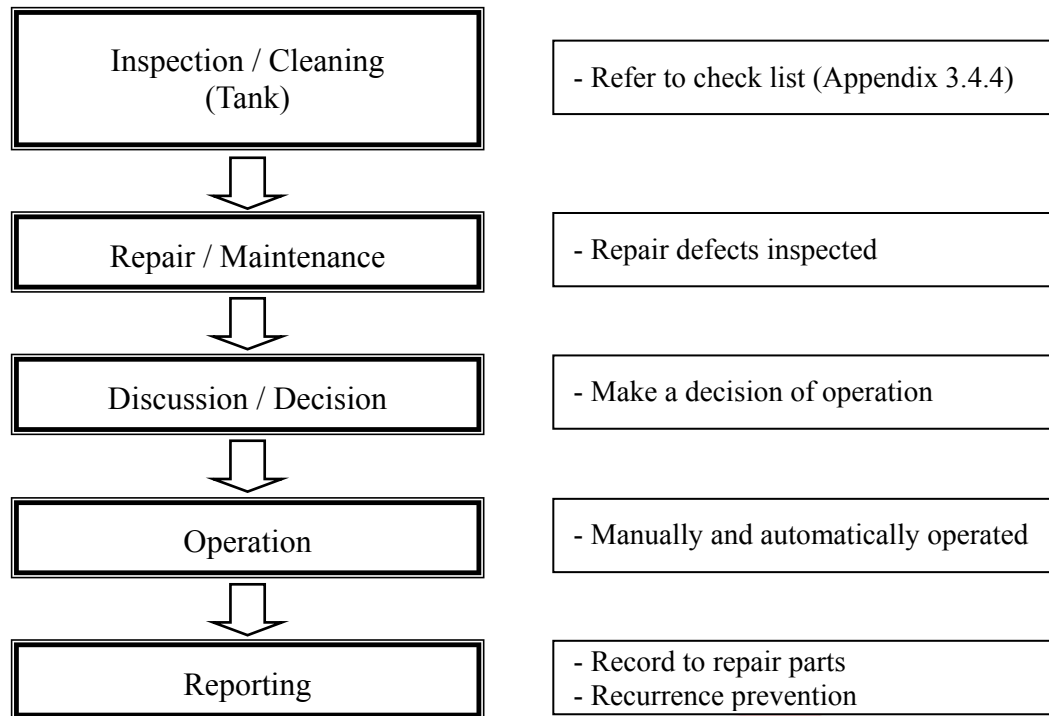


Figure 5. Procedure of maintenance



## 2. Supervision

All activities including BioViolet™ BWMS process, test facility maintenance, cleaning and operation must be controlled under KOMERI's supervision to ensure the quality of control for testing of BioViolet™ BWMS.

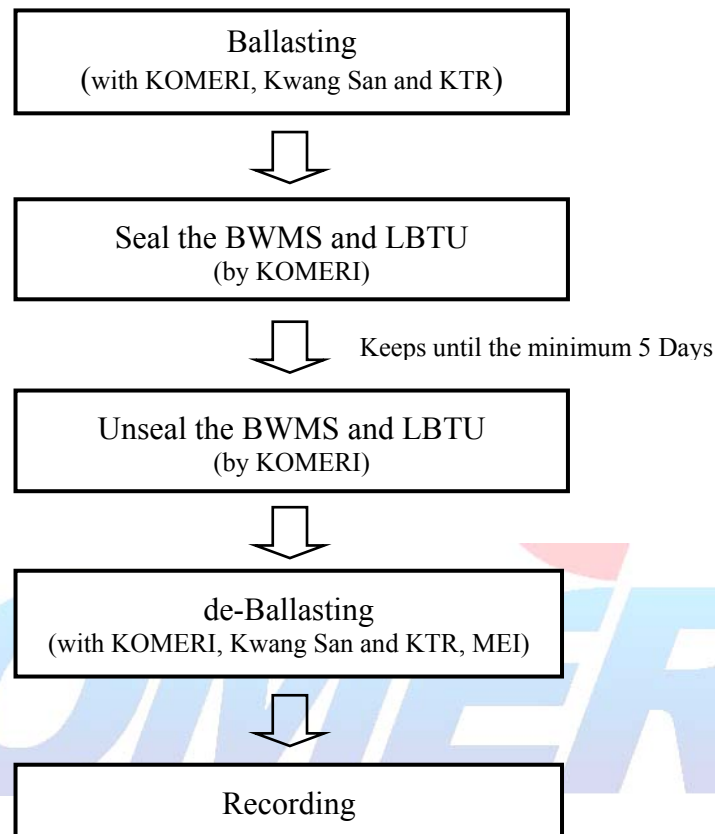


Figure 6. Procedure of supervision

\* Remarks: Test site was secure and protected by guard (staff of the Kwang San). Anyone can't get into BioViolet™ BWMS place without the security permission.

## 2. 1 Task responsibilities

<b>Test water manipulation</b> by KOMERI	Injection of viable organisms ( $\geq 50 \mu\text{m}$ organisms, $\geq 10 - 50 \mu\text{m}$ organisms), heterotrophic bacteria in Tank.
	Check the test water for basic water parameters and sampling.
	Seal and unseal the BWMS and test facility.
	Check of UV intensity, flow rate, TRC.
<b>Test facility operating</b> by Kwang San	Injection of viable organisms ( $\geq 50 \mu\text{m}$ organisms, $\geq 10 - 50 \mu\text{m}$ organisms) in Tank.
	Check and operate all valves.
	Check and operate agitator.
	Check of filtration unit, UV chamber, flow rate, TRC.
<b>Cleaning of the test facility</b> by Kwang San	TANK 1, 2, 3

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## 2.2 Cleaning of test facility

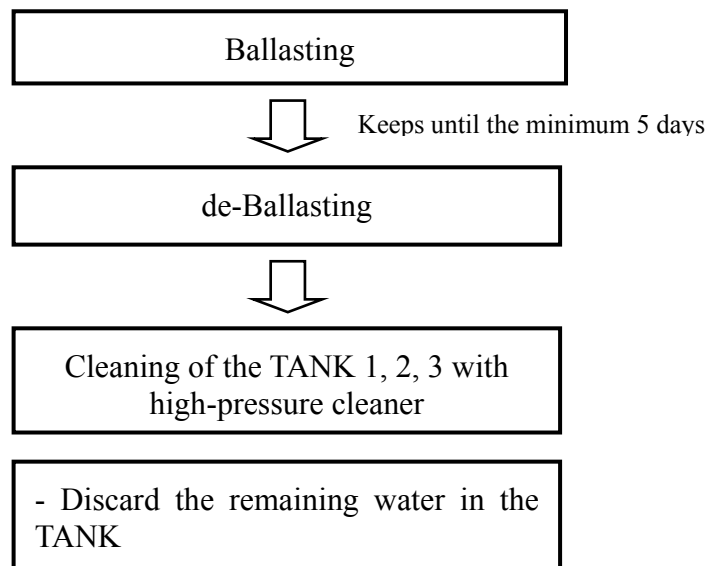


Figure 7. Cleaning procedure



### **3. COC RECORD**

#### **3. 1 Ballasting procedure records**

Ballasting procedure record and operation log sheet are to be prepared by a record format during Ballasting operation and then bound for keeping (Appendix 3.4.4).

#### **3. 2 de-Ballasting procedure records**

de-Ballasting procedure record and operation log sheet are to be prepared by a record format during de-Ballasting operation and then bound for keeping (Appendix 3.4.4).

#### **3. 3 Maintenance**

Before ballasting operation, the checklist for cleaning of the BioViolet™ BWMS is to be conducted on every test cycle (Appendix 3.4.4).

#### **3.4 Supervision**

After ballasting operation, seals of the BioViolet™ BWMS and test facility are to be conducted on every test cycle. Before de-Ballasting operation, seals of the BioViolet™ BWMS and test facility are to be removed (Appendix 3.4.4).

*KOMERI*